# National Ignition Facility

FACTS

## Purpose

The National Ignition Facility (NIF) will use the world's largest laser to compress and heat BB-sized capsules of fusion fuel to thermonuclear ignition. NIF experiments will produce temperatures and densities like those in the Sun or in an exploding nuclear weapon. The experiments will help scientists sustain confidence in the nuclear weapon stockpile without nuclear tests as a unique element of the National Nuclear Security Administration's Stockpile Stewardship Program and will produce additional benefits in basic science and fusion energy.

## The Buildings

- NIF is 704 feet long, 403 feet wide, and 85 feet tall—about the size of a football stadium—and consists of three connected buildings:

  - Optics Assembly Building (OAB)
  - Laser Building (LB)
  - Target Area Building (TAB)
- The $260 million, 7-acre NIF building complex was completed on schedule and within its allocated budget on September 30, 2001. The OAB is undergoing commissioning of laser component assembly workstations.
  - Concrete poured: 73,000 cubic yards.
  - Steel and rebar erected: 12,700 tons.
  - Earth moved: 210,000 cubic yards.

## The Laser System

- The 192 laser beams of NIF will generate
  - A peak power of 500 trillion watts, 1000 times the electric generating power of the United States.
  - A pulse energy of 1.8 million joules of ultraviolet light.
  - A pulse length of three to twenty billionths of a second.
- Optical components:
  - 7500 large optics including 3072 laser glass slabs as well as large lenses, mirrors, and crystals.
  - More than 15,000 small optical components.
- Precision optics: total area of 33,000 square feet (3/4 of an acre). More than 40 times the total precision optical surface in the world's largest telescope (Keck Observatory, Hawaii).
- Laser beams: 16-inch by 16-inch beams of infrared laser light (1-micron wavelength). The infrared beams are converted to ultraviolet beams (0.35-micron wavelength) at the target chamber.
- Laser pulse amplification:
  - In the master oscillator room, the initial 1 billionth of a joule pulse is amplified 10,000 times, then split into 48 separate laser pulses.
  - In the preamplifier module, each of the 48 pulses is further amplified 20 billion times, then split 4 ways to create 192 pulses.
  - In the main laser system, each propagated pulse is amplified another 15,000 times.
  - Total amplification = 3 quadrillion (3 million billion).

## Laser and Optical System Cleanliness

- The high optical intensities of the NIF laser beams requires the laser beampath and optics to have a precision-cleaned environment for reliable operation.
- NIF cleanliness requirements for optics assembly areas are similar to those required for semiconductor fabrication.
- There are 400,000 square feet of structural surfaces



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in the NIF laser and beampath that require precision cleaning.

## The Target Experimental System

- Experiments consisting of laser targets and supporting systems are contained inside a 33-foot-diameter, 1 million-pound aluminum target chamber. The walls of the target chamber are 4-inches thick and coated with an additional 16 inches of concrete for radiation shielding.
- NIF scientists will conduct approximately 700 experiments each year where target materials will typically reach temperatures of 100 million degrees and densities up to 20 times that of lead.
- NIF ignition targets consist of a BB-sized plastic sphere containing frozen and gaseous fusion fuel, surrounded by a gold cylinder called a hohlraum, about the size of a cold capsule.
- NIF's 192 laser beams will be focused into 48 spots on the inner walls of the hohlraum, creating x-rays that drive the implosion of the fusion capsule, compressing it to one-thirtieth of its original size when the thermonuclear ignition process begins.

## The NIF High Energy Density and Ignition Physics Program

- NIF experiments in support of the Stockpile Stewardship Program measure properties of materials and phenomena that occur at extreme temperatures and pressures, and under highly dynamic conditions. Weapons scientists will use the data generated on NIF to model, predict, and resolve problems that may be found in our aging nuclear stockpile without resorting to full-scale nuclear testing.
- Basic scientific experiments will also be performed on NIF to help astrophysicists understand the phenomena occurring deep within stars or the conditions that existed in the universe shortly after the big bang.
- Experiments will be fielded on NIF to study and understand inertial fusion energy. These experiments will help to increase the likelihood of full-scale fusion-energy-based power plants.

The NIF laser target chamber with hohlraum (inset).

*Questions concerning the National Ignition Facility at LLNL should be directed to the LLNL Public Affairs Office, (925) 422-9919*